point P of the bowl with the horizontal green is

$$v_P = v - a\omega = (V - \mu g t) - \frac{\mu g a^2}{k^2}t = V - \mu g\left(1 + \frac{a^2}{k^2}\right)t.$$

Skidding ceases when v_P becomes zero. i.e. when

$$t = \frac{V}{\mu g\left(1 + a^2/k^2\right)} = t_1 \text{ (say)}.$$

At this time,

$$v = V - \mu g t_1 = V - \frac{V}{1 + a^2/k^2} = \frac{a^2}{k^2 + a^2}V = v_1, \text{ (say)}.$$

As this shows $v_1 > 0$, *rolling begins* at $t = t_1$.

For $t \geqslant t_1$, the equations of motion are (Figure 2)

$$m\dot{v} = F, \qquad mk^2\dot{\omega} = -Fa$$

and $v - a\omega = 0$ (the rolling condition). The last two equations give $mk^2\dot{v} = -Fa^2$ which, together with the first, shows $-ma^2\dot{v} = mk^2\dot{v}$, i.e. $0 = m\left(k^2 + a^2\right)\dot{v}$, so $\dot{v} = 0$ and therefore (for $t \geqslant t_1$)

$$v = v_1 = \frac{a^2}{k^2 + a^2}V = \tfrac{5}{7}V$$

if we take $k^2 = 2a^2/5$; and then $t_1 = 2V/7\mu g$. The *distance skidded* is

$$d = \tfrac{1}{2}(V + v_1)t_1 = \tfrac{1}{2}(V + \tfrac{5}{7}V)\frac{2V}{7\mu g} = \frac{12V^2}{49\mu g}.$$

All this, however, ignores bias.

As a retired lecturer in mathematics with experience of teaching civil engineers, I was intrigued by John's final paragraph in which he sets 'geometry' apart from (the rest of ?) 'mathematics'—pure reasoning thought in contrast to mere brute calculation?

Yours sincerely,

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DEAR EDITOR,

About 30 years ago 'Eperson's Conjecture' (that the sum of three consecutive square numbers can always be expressed as the sum of three other square numbers) was published in *The Mathematical Gazette*, and was proved to be valid by a number of readers who supplied algebraic formulae [1, 2]. In sorting out my papers (an accumulation of many years of investigations) I found today '*Eperson's Second Conjecture*' that three times the square of every odd number can be expressed as the sum of three other square numbers. I have tried in vain to prove this is valid but I have verified it from $3\left(3^2\right)$ to $3\left(23^2\right)$ as shown below.

n	$3n^2$	
3	27	$= 1^2 + 1^2 + 5^2$
5	75	$= 1^2 + 5^2 + 7^2$
7	147	$= 1^2 + 5^2 + 11^2$
9	243	$= 1^2 + 11^2 + 11^2 = 3^2 + 3^2 + 15^2 = 5^2 + 7^2 + 13^2$
11	363	$= 1^2 + 1^2 + 19^2 = 5^2 + 7^2 + 17^2$
13	507	$= 5^2 + 11^2 + 19^2 = 7^2 + 13^2 + 17^2$
15	675	$= 1^2 + 7^2 + 25^2 = 5^2 + 11^2 + 23^2$
17	867	$= 1^2 + 5^2 + 29^2 = 11^2 + 11^2 + 25^2$
19	1083	$= 1^2 + 11^2 + 31^2 = 11^2 + 11^2 + 29^2$
21	1323	$= 1^2 + 19^2 + 31^2 = 3^2 + 15^2 + 33^2$
23	1587	$= 1^2 + 19^2 + 35^2 = 7^2 + 13^2 + 37^2 = 1^2 + 25^2 + 31^2$

Would this be of interest to readers of *The Mathematical Gazette* ?

References

1. D. B. Eperson, Triangular numbers and square numbers, *Math. Gaz.* **51** (October 1967) pp. 242-243.
2. R. Goodall, Epersonal column (i), *Math. Gaz.* **52** (October 1968) pp. 273-274.

Yours sincerely,

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P.S. On June 5th 1998, I shall have been a life member of the Mathematical Association for 70 years; I have just discovered the notice of my election – signed by C. Pendelbury (Hon. Sec.).

Editor's note. Nick Lord informs me that L. E. Dickson (*History of the theory of numbers*, volume 2, p. 263) gives two non-elementary approaches to the proof of Eperson's second conjecture (so it is *definitely* true). Readers are invited to provide an elementary proof.

https://doi.org/10.1017/S0025557200225953 Published online by Cambridge University Press